Translation of Description of EP1410766

[0001] The present invention refers generally to a laser system with a light guide for the Strahlführung of the generated laser radiation and in the particular one to a light guide for applications in the medical range.

[0002] Always numerous becoming applications of the laser technology in the medicine those lead the handling of the laser systems facilitated and improved and/or to the development of technical ever more matured laser constructions and corresponding system concepts. again new operational areas opened.

[0003] In this connection a substantial importance comes to the use of flexible optical transmission systems for the generated laser radiation, because for the application of the laser radiation on or into the therapy place the Entfemung between the laser apparatus exit and the patient must become bridged. The medical laser systems exist therefore typically of a stationary or mobile laser apparatus, a Strahlführung, optical terminals and accessory for particular medical applications. For the transmission of visible laser light and the adjacent spectral regions of approx. 0,3 mu m to 2.1 mu m become flexible glass and/or. Quarzfasern used. In the spectral regions of 0,19 mu m to 0.3 mu m (EximerLaser) and 3 mu m to 10 mu m (erbium and CO2-Laser) find particular light guides or mirror joint arms application.

[0004] High demands become particularly high-energy provided to the light guides with the transmission pulsed, laser radiation. The good handling and flexibility of these transmission systems are from critical importance for the use of the laser systems.

[0005] The for this used light guides have the most different specifications concerning transmission behavior, maximum applizierbarer laser power, expiration date with sterile fibers etc. These specifications give certain boundary conditions regarding the insertable certain light conductor types in combination with certain lasers or treatment parameters. The adherence to these boundary conditions becomes to date usually communicated over the operating instruction, which is provided with the laser or the light guide, with the user. The responsibility lies thereby with the user of a laser apparatus and cannot become not by a control system in the laser apparatus tested.

[0006] The sequences with neglect or misinterpretation of these boundary conditions by the user e.g. are. Destruction of the fiber, to small laser power at the fiber end or a treatment with a unsterilen fiber. The corresponding result can be a unsuccessful treatment or an immediate health endangerment of the patient.

[0007] If it comes into sequence its to demands for adhesion on the part of the user because of a malfunction of a damaged fiber or on the part of the patient because of health damage, can afterwards between a quality defect with the fiber and a disregard of the boundary conditions for the use of the light guide by the user any longer distinguished do not become.

[0008] Here comes a mark light guides for a contact and/or. contact-free laser therapy a particular importance too, since they are problem-free far common with endoscopes and other laser instruments of control used to become to be able and due to their advantages. They are immediately more insertable, are sterile packaged and starting from work with comprehensible quality are delivered.

[0009] It is therefore the object of the present invention to indicate a laser system and a light guide those the adherence to the boundary conditions to the use of a light guide in the laser system not possibly facilitates and faulty operations of the laser system in connection with the light guide and/or. make comprehensible.

[0010] This object becomes in inventive manner 16 dissolved by the subject-matter of the claim 1 and. Advantageous embodiments of the invention are subject-matter of the Unteransprüche. The present invention develops on the finding that a connected transponder fixed with the light guide can convey identification data to the laser apparatus and the laser apparatus parameter attitude to the transponder of the light guide, which a later time evaluated to become to be able.

[0011] The one achieved can therefore become by the solution according to invention that the laser apparatus spends a warning with wrong adjustment of the boundary conditions regarding the light guide and/or. Laser apparatus attitudes due to the made automatic of the transponder transmitted data become. On the other hand achieved becomes that to the evaluation, whether a quality defect with the light guide or an application error is present, which can be consulted with the use of the light guide recorded parameter attitudes. This is particularly important for a mark light guides, since their quality and load limits are a corresponding application of therapies designed.

[0012] In accordance with a prefered embodiment the included laser system a laser apparatus to the generation of laser radiation and a light guide for the jet guidance of the generated laser radiation. A data carrier for identity data is fixed connected with the light guide. Additional one is a Leseeinrichtung to the read of the identity data in the laser apparatus disposed.

[0013] In accordance with an other prefered embodiment the included laser system a laser apparatus to the generation of laser radiation and a light guide for the jet guidance of the generated laser radiation. A data carrier for identity data is fixed connected with the light guide. Additional one is a Leseeinrichtung to the read of the identity data in the laser apparatus

disposed. The data carrier is a transponder, which is both more readable and more writable. For this the Leseeinrichtung in the laser apparatus has also writing means to the contactless writing of data into the transponder. As identity data e.g. are. Informations over a manufacturer of the light guide, an expiration date of the light guide, transmission of the light guide, type designation of the light guide or fiber diameter of the light guide in the transponder stored. Beyond that additional also data become stored over a specific use of the light guide in connection with the laser apparatus. These usage data contains informations over the light guide of supplied laser energy, number of the laser pulses, number of the treatments with the light guide, date of the treatment or identification data of the laser apparatus. Usage data already stored is not more erasable, more rewritable or alterable any longer. The identity data and the usage data are stored thereby encrypted in the transponder. The light guide is attached by means of a fastener releasable at the laser system and the data carrier in the part of the fastener essentially inseparably mounted mounted at the light guide. Preferably the transponder is in the part of the fastener mounted at the light guide molded or bonded thus welded or.

[0014] In accordance with an other prefered embodiment of the present invention a light guide becomes the Strahlführung of laser radiation presented, which can by means of a fastener more releasable be linked at a laser apparatus and a data carrier for identity data with the light guide is fixed connected.

[0015] With an alternative of this prefered embodiment of the present invention the data carrier is a transponder, which is both more readable and more writable, in order to store additional also data over a specific use of the light guide in connection with a laser apparatus. The identity data stored in the transponder contain informations over manufacturers the light guide, expiration date of the light guide, transmission of the light guide, type designation of the light guide or fiber diameter of the light guide. The usage data stored in the transponder contains informations over the light guide a supplied laser energy, number that the light guide of supplied laser pulses, number of the treatments, date of the treatment or identification data of the laser apparatus. The stored usage data is not preferably any longer erasable and only limited ones more rewritable or alterable. Both identity data and usage data are encrypted in the data carrier stored. The fastener of the light guide is from a material, electromagnetic radiation in the frequency range of a sending and a receiving area of the transponder essentially does not shield and preferably from art off exists. The light guide is with the fastener essentially inseparably connected and the transponders with the fastener welded, bonded or molded.

[0016] On the basis the prefered embodiments represented in the accompanying designs the invention becomes in the following more near explained. Similar or corresponding details are provided in the figs with same designations. Show:

Fig. 1 a schematic representation of a laser system in accordance with a prefered embodiment of the present invention,

Fig. 2a and 2b an other schematic representation of a prefered embodiment according to the present invention,

Fig. 3 a flow chart for the schematic flow of the data communication between the transponder of the light guide and the reading and writing means of the laser apparatus in accordance with a prefered embodiment of the present invention, and

Fig. 4 a schematic overview of the usage data in accordance with a prefered embodiment of the present invention, stored in the transponder.

[0017] Fig. 1 shows on the basis a schematic. Representation a laser system in accordance with a prefered embodiment of the present invention. The laser system 100 consists of a stationary or mobile laser apparatus 110, which a mechanism to the generation of laser radiation included, to which a flexible light guide can be linked 120 for the Strahlführung of the generated laser radiation.

[0018] The laser apparatus is provided to the generation of intense laser radiation with high-power laser diodes, a micro optics for focusing the generated laser light as well as a power supply. Alternative one is the laser apparatus with a laser medium, a resonator and a pump source as well as the corresponding power supply provided. In this case prefered-prove diode-pumped solid laser media application for the generation of the intense laser radiation find.

[0019] Beyond that the laser apparatus has the power of the laser radiation, the pulse duration as well as the frequency of the laser pulses a cooling device as well as a system controller, that among other things also preferably regulates. Beyond that indicating and control mechanisms are integrated into the laser apparatus, over which certain application modes as well as system attitudes selected to become to be able. The other one the laser apparatus has corresponding safety devices both for the electrical as well as for the optical range. Preferably the system controller possesses corresponding mechanisms, in order to be able to accomplish the control and control of the laser system over software programmes. Thereby an embodiment is particularly favourable exchanged with which software programmes become with an update.

With an other alternative of the prefered embodiment of the present invention an output unit for a protocol of the system attitudes is integrated and/or into the laser apparatus. the laser apparatus exhibits an interface for an output unit. The other one a fastener is 140 integrated into the laser apparatus, which serves 120 for the fixed or releasable attachment of the light guide. The fastener is preferably a putting, a screwing of the bayonet connection, whereby the part of the fastener attached at the laser apparatus is preferably 150 distinct as sleeve 160 and the part attached at the light guide as plugs. Particularly becomes the releasable attachment of the light guide a so called SMA connector prefered-proves used.

[0020] The light guide can consist several plastic, glass or quartz glass fibers of or. Depending upon wavelength of the generated laser radiation also doped quartz glass fibers become used. The light guide is designed to be able to transport high light powers as lossless ones as possible. It preferably has from safety reasons a corresponding jacket, which protect the fiber against corresponding mechanical stress and in the case of a fracture of the fiber against withdrawing the laser radiation. Particularly concerns it prefered-proves with the light guide 120 a so called a mark light guide. This is a sterile packaged therapy fiber to the unique use.

[0021] The plug 150 is preferably from a material, electromagnetic radiation in the frequency range of a sending and a receiving area of the transponder essentially preferably does not shield and from plastic. The plug and the light guide are connected essentially inseparably with one another. Into the plug 150 is a transponder introduced. On this type are the optical fiber, the sleeve of the fastener and the transponder fixed connected with one another. Prefered way is the transponder fixed in the sleeve welded, bonded or molded, so that it cannot become remote.

[0022] The transponder contains vintage/writing memory to the receptacle of all relevant informations, which become with the preparation of the therapy light conductor and generated during the use at the laser apparatus. The laser apparatus becomes for this armed with a board reading and describing the light conductor transponder. The data transmission made wirelessly in the RF 3.5 kHz band by means of antenna. Like mentioned already above, data on an electronic data carrier become stored in the laser system. Prefered way for this so-called become. RFID systems (radio frequency identification) used. At the light guide which can be identified are so-called. Transponder mounted. The power supply of the transponder as well as the data exchange between transponders and reader made however not by galvanic contact, but contactless by means of more magnetic or electromagnetic fields.

[0023] The RFID system always consists of two components, which mentioned above transponder 130, which is at the light guide mounted which can be identified and a reader 170 with antenna unit 140, which depending upon embodiment both when reading and and

write/Lese-Einrichtung performed is. The reader is alternative coupled with a local computer network. The reader is preferably connected with the system controller of the laser apparatus.

[0024] The reader preferably essentially consists of a control unit and a high frequency interface (HF-interface). Fundamental object of the reader is the activation of the transponder, the structure of a communication and the transport of the data between an application software of the system controller of the laser apparatus and the contactless data carrier. For the two data flow directions of and to the transponder two separate signal courses are available within the HF-interface. Data, which become the transponder transmitted, go through the branch of transmitter. However data, which will receive from the transponder, in the branch of receiver become conditioned.

[0025] In the RFID system both an exchange of data takes place and from energy. Within the transponder receiving antenna is a transducer connected between memories and sends/, which converts the analogue signals of the antenna into for the memory usable, digital signals. The complete flow becomes monitored thereby by a control logic in a microchip of the transponder.

[0026] Outside of the range of pick-up of a reader the transponder passive behaves, since it usually possesses no own power supply. Only within the range of pick-up it becomes activated by the reader, as the operation of the transponder required energy becomes transmitted over a transmission/receiving antenna. Prefered way is more programmable the transponder and without battery (passive). Alternative ones find also fixed programmed transponders with or without battery application or so-called. semipassive transponders, with which the microchip of a battery fed only used inductive for the data transmission the field of the reader becomes.

[0027] In the laser system RFID systems with various ranges become used depending upon application purpose. The one CLOSE Coupling systems become, thus as narrow coupling systems with very small range of up to approx. 0.01 m inserted. The transponder must become here either into a reader inserted or on a surface planned for it positioned. To the transmission arbitrary frequencies up to 30 MHZ come to the use. By the narrow coupling between data carriers and reader will require large amounts of energy for applications ready provided, which place corresponding safety requirements, however no large range.

[0028] Alternative ones become remote Coupling systems used, which make ranges possible of up to 1 m. They have all the inductive coupling between reader and transponder common. As transmitter frequencies typically frequencies of bottom 135 kHz as well as the range become used around 13,56 MHZ.

[0029] With an other alternative Long ranksystems become used, with which ranges are from significant over 10 m possible. The transmitted energy in no case is sufficient, in order to supply the transponder with sufficient energy to the operation of the microchip. A supporting battery

places then the exclusive energy for the microchip and the maintenance of the stored data ready (semiaktive power supply). The transmitter frequencies lie here typically in the microwave range (2.45 - 5.8 GHZS).

[0030] Prefered way becomes as inexpensive alternative a READ Only transponder used. As soon as the READ Only transponder comes into the range of pick-up of the reader of equipment 170, begins the output of a certain identifier (serial number) of the transponder, which became applied during microchip production. This identifier as well as other data are by the factory unchangeable into the memory of the transponder written.

[0031] Particularly becomes as other alternative a transponder prefered-proves used, which is armed by the reader several times with data more writable and with a READ/a Write memory. The data transmission made typically block-by-block. That is, that a defined number from bytes becomes to a block summarized, which becomes then only as whole read or described. This block structure possible thereby a simpler addressing in the microchip and by the reader. The memory sizes READ/Write transponder vary depending upon application typically between 1 byte and 64 kByte.

[0032] For applications of the therapy fiber, is not necessary with which a multiple redescription, an alternative Write Once transponder becomes used, which is only once more writable.

[0033] In order to protect the stored data from undesirable access, prefered-proves in the microchip a so-called becomes. Kryptoeinheit integrated, which becomes the identification, data encryption and key administration used. Prefered way offers the Kroptoeinheit a password protection and a by the factory set 64-Bit key.

[0034] Fig. 2a and 2b show a particularly prefered embodiment of the present invention on the basis other schematic representation. The light guide 120 is 210 fixed connected with the plug and the connector housing. Prefered way is the light guide essentially inseparably with puts connected. The light guide is led out thereby by the plug performed and at the open end of the plug, so that at this end the generated laser radiation is linkable into the light guide.

[0035] Into the interior of the plug the transponder is 130 prefered-proves with potting compound 220 cast in, so that it is essentially inseparable connected with the light guide and the plug. Alternative one is welded the transponder into the connector housing or with the connector housing bonded. Alternative ones are to be connected to other mounting options provided, which make it possible, the transponder inseparably with the light guide and the plug and/or. it ensures that a non destructive removal of the transponder from the plug is not possible. In this way ensured becomes that the transponder is always coupled with the light guide and the identification and usage data stored in the transponder become always entrained

with the light guide. This possible to the one that a faulty operation of the laser apparatus in connection with the light guide can become prevented, and on the other hand becomes ensured that the history of the use of the light guide is at any time comprehensible.

[0036] In the laser apparatus the counterpart is 160 for the connector 150 in that housing wall 230 of the laser apparatus mounted. Like mentioned already above, alternative threaded connections or other fasteners become used. Particularly find here so-called prefered-prove. SMA connectors use.

[0037] Depending upon mentioned above, used type of transponder a corresponding sending and receipt mechanism are 140/170 disposed in the laser apparatus. Prefered way concerns here it an antenna 140, which is in the vicinity of the putting or threaded connection 150/160 mounted. In this way ensured becomes that the reception of the RFID system corresponding reliable functioned and a sufficient good signal to noise ratio is ensured. Sending and receipt mechanism 140/170 as well as the transponder 130 are so disposed that they become shielded essentially not by components of the laser system, so that a corresponding good reception is in the RFID system to ensured as in Fig. 2b apparent.

[0038] The antenna 140 is coupled with a high frequency interface, which is again connected with a control unit. By the control unit receipt and transmission data with the high frequency interface become exchanged. The control unit is prefered-proves connected with the system controller of the laser apparatus. By the fact it becomes possible that the light conductor data picked out from the transponder can be picked out over the high frequency interface and be passed on over the control unit to the system controller. The system controller can refer either by instructions to the display device necessary system attitudes or make automatic corresponding system attitudes, whereby a faulty operation of the laser apparatus with the used light guide becomes minimized. This concerns typically to adjustments of the maximum pulse energy and/or. - duration as well as the maximum possible number of laser-pulsed, which become guided over the light guide a use place: Beyond that alternative registered becomes whether it concerns with the light guide a multiple useful light guide or whether it concerns a once useful light guide. For the latter case is to be selected alternative provided application data corresponding with the use of a mark therapy fibers first from with the a mark light guide coupled transponder to evaluate and if the a mark therapy fibers already used became, to indicate a corresponding warning at the display device and/or. to prevent the emission of a laser pulse over the light guide.

[0039] In an alternative embodiment the RFID system at to the laser apparatus the opposite end of the light guide mounted, above all if it concerns here a light guide, at its end is a plug/a combination of piece of grasp for a so-called. Applicator provided is. Here the made read and writing of the data over an antenna as well as electronics mounted in the Griffstück. Alternative

one can be sending and receiving unit of the RFID system also in the laser apparatus direct mounted, if a remote Coupling system with a range up to 1 m or a so-called. Long ranksystem with a larger range used becomes.

[0040] Fig. a flow chart for the schematic flow of the data communication shows 3 between sending and receipt mechanism of the laser apparatus and/or. the mentioned above handpiece and the transponder in accordance with the prefered embodiment of the present invention, connected with the light guide. In step 310 initiated either the system controller of the laser apparatus or the control unit the start of program routines.

[0041] In step 320 the identity data from the transponder are picked out. If the read of the identity data is not possible, a corresponding warning on the display device becomes displayed and/or. the emission is prevented by laser-pulsed. Alternative ones are selected in step 320 the additional application data from the transponder. If an a mark light guide is present, checked becomes whether corresponding application data are deposited already in the transponder and/or. whether the a mark light guide already used became and corresponding data in the transponder stored became. For this case a corresponding warning on the display device becomes shown and/or. the emission prevented by laser-pulsed. If a multiple useful light guide is present, the application data are picked out and checked whether the laser power emitted over the light guide exceeded a specific limit and/or. the possible number of uses, maximum for the warranty of the proper function of the light guide, is not yet exceeded. If one of the values is exceeded, like mentioned already above, a corresponding warning on the display device becomes shown and/or. the emission prevented by laser-pulsed.

[0042] In step 330 the corresponding identity data are passed on over the control unit of the high frequency interface to the system controller of the laser apparatus. These identity data preferably contain informations over the manufacturer, the expiration date, an average transmission achievement, a maximum transmission achievement, the type designation or a fiber diameter of the light guide. Beyond that other data can be to the identification of the light guide such as production number, ticket number, manufacturing date or similar in the transponder stored.

[0043] The system controller, like already mentioned takes corresponding these data in the laser apparatus corresponding system attitudes forwards, i.e. it becomes the laser power, the pulse duration or the maximum possible number of laser-pulsed automatic set. Alternative one is provided that with manual operation of the laser apparatus when adjusting wrong parameters of the system controllers over the display device corresponding warnings and/or. Correction suggestions spends.

[0044] In this way ensured becomes that a faulty operation of the laser apparatus in connection with the light guide becomes prevented. The risk to adjust laser energies and laser pulse lasting those to the destruction of the light guide and/or. to a false treatment, become thereby minimized would lead.

[0045] In step 340 the reception of the HF-interface becomes the transponder checked. In this way ensured becomes that corresponding application data, like e.g.

[0046] Laser pulse energy and laser pulse duration also into the transponder written to become to be able. If no reception is 130 possible to the transponder, a corresponding warning becomes over the display device shown in step 350. The flow of the control begins then again with step 320 with the read of identity data from the transponder. If a corresponding safe reception is ensured to the transponder, with step 360 one continues.

[0047] In step 360 over the system controller the corresponding system attitude recorded is passed on and to the control unit of the high frequency interface. In step 370 the application data determined of the system controller are passed on to the transponder and written. In step 380 the checked system controller or the control of the high frequency interface whether other laser pulses for the laser application become emitted. If other laser pulses for the laser application become emitted, the control continues with step 320. Otherwise the control process with step becomes 390 terminated.

[0048] Alternative one is selected in step 320 from the transponder an additional manufacturer identification of the light conductor manufacturer and evaluated, in order to examine whether the light guide of an authorized manufacturer became made.

[0049] Fig. a schematic representation of an overview of the usage data stored in the transponder shows 4 in accordance with a prefered embodiment of the present invention. The system controller a determined corresponding date as well as time of the application as well as the corresponding laser pulse energy and laser pulse duration. These informations become transmitted together with an identification number of the laser apparatus over the control unit of the HF-interface to the transponder. Becomes each single laser pulse, which became emitted over the light guide of the laser apparatus, as mentioned already above, in that transponder provides recorded and with a continuous number.

[0050] This possible it to reconstruct the history of the use of the light guide. For this the light guide with a corresponding evaluation device becomes connected, which picks the corresponding identity data and usage data out stored in the transponder, decrypted and evaluates. Prefered way are the data in the transponder over the mentioned above Kryptoeinheit encrypted stored, in order to secure it before manipulation or falsification. The data in the transponder are not more erasable and/or. not rewritable or not alterable

deposited. In this way ensured becomes that the data stored in the transponder show essentially genuinely all uses of the light guide. It is possible to reconstruct in the case of a damage of the light guide in what respect a faulty operation of the laser apparatus and/or. niece contents of the boundary conditions to the operation of the light guide is causal. In this way an examination, whether a quality defect is present or niece contents of the boundary conditions to the application of the light guide, becomes substantial facilitated and a significant safety advantage for the manufacturer of therapy fibers, particularly for a mark therapy fibers, provided.

[0051] The present invention is not on the enumerated prefered embodiments of limited, but extended itself also all embodiments prefered on the combination.

[0052] The other one limited itself the present invention on the range of the medical application, but cannot become equivalent for ranges of the material processing as well as material analysis used.